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An information decision support system towards the formulation of a modern energy companies' environment

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Abstract

The development of the renewable energy sources (RES) and the energy efficiency (EE) is related to the enhancement of the energy companies' (energy producers by RES and energy services companies—ESCOs) operational environment. The aim of this paper is to present an information decision support system, which consists of an expert subsystem, as well as a multi criteria decision making (MCDM) subsystem. The system supports the state toward the formulation of a modern environment, since it incorporates the "new parameters" of the energy market, namely the liberalization and the climate change. The system was successfully applied in the 13 accession member states of the EU.

Keywords: Energy companies' environment; Decision support

Contents

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1. Introduction

Chandler [1] outlines that the operational environment of companies determines substantially the main long-lasting objectives and aims of each company, fires a line of action and indicates the necessary means for the accomplishment of these objectives. Johnson and Scholes [2] note that the environment directs decisively the activities of a company in the long run. In addition to this, Ansoff [3] supports that the existence of the companies' operational environment is the base of creation of common lines between the activities of a company.

In the above context, one of the most important parameters for the renewable energy sources (RES) development is the enhancement of the involved producers. These producers can be either companies deriving from utilities producing energy from conventional sources that have decided to be activated in the field of RES or independent power producers (IPPs) [4].

Moreover, energy service companies (ESCOs) have been developed and their role is crucial for the promotion of energy efficiency (EE) [5]. The success of the above energy companies is based on the formulation of a modern environment especially in each Europe Union (EU) member state. As a result, each member state needs to formulate an up-to-date energy companies' environment, which has to be enhanced, thus giving the opportunity to more companies in these member-states to be properly activated.

Based on the international literature, a large body of scientific papers examines the external factors of the energy companies in terms of policies, regulations and financing support schemes of these states. However, there are no studies investigating the operational environment of energy companies in an integrated way.

On the other hand, the use of the expert systems, as well as the use of the multi criteria decision making (MCDM) systems, can help states assess and evaluate the companies' operational environment. In particular, during the last years the expert systems are considered to be programs with a wide knowledge base in a limited space that use complex knowledge for the execution of works that an expert human could do. An expert system is the incorporation in the computer of a component based on knowledge, so that the system will be able to provide a logical advice regarding a processing function or to have the ability of decision making. A conventional system uses mathematical models for the simulation of the problem, while the expert system simulates the human arguing regarding the problem [6]. Furthermore, the purpose of MCDM systems is to correlate efficiently the

various characteristics of any given problem and as a result to demonstrate the best possible solution to any problem [7,8].

As a result, the above-mentioned methods can be very useful for each state, i.e. the "decision maker" of defining importance, shaping the environment of energy companies' operation. In this context, the main aim of this paper is to present an information decision-making system based on a "multidimensional" methodology for the formulation of a modern energy companies' operational environment, which also incorporates the "new parameters" that are introduced into the energy market, namely the liberalization [9] and the climate's change effect [10]. This system is based on the philosophy of expert and MCDM systems. It was applied in order to support the decisions toward the formulation of the operational environment of the energy companies in the 13 new and candidate member states of the EU.

The paper is structured in five sections. Apart from the introduction, the Section 2 presents a brief literature review for the related systems aiming at supporting the innovation of the current system. Section 3 provides a description of the adopted methodology and Section 4 presents the developed information system and its application. The last Section 5 presents the conclusions, which summarize the main points that have been drawn up in this paper.

2. A brief review of related systems

2.1. General

Based on the literature survey, there exist a number of energy planning systems that are related to the current problem [11–13]. In particular, some of the requirements of current environment's analysis could be supported through the supply systems (EFOM, ELFIN, MARKAL, MESSAGE, TESOM, UPLAN-E and WASP), demand systems (IIASA, COMMEND, ENPEP, MAED, HELM, MED-PRO) [14] or the system of integrated planning of resources (IRP-MANAGER, MARKAL) [15,16]. As a result, there are no decision systems supporting the operational environment of energy companies in an integrated way.

2.2. Expert systems

The expert systems are used for at least 15 years in the energy market. To the best of our knowledge, one of the first expert systems is a system (ALFA) of short-term forecast of electrical charge that was materialized by Jabbour [17]. Since then, many forecast systems were presented, while the most important of them were reported in the works of Hung et al. [18] and include the following: SOLEXPERT, ALEX, PANexpert, TRANSEPT and CISELEC.

Furthermore, many systems for short-term forecast load exist, as reported in the review of Kagiannas et al. [19]. Other models, as described by Markovic and Fraissler [20] and Kandil [21], use the expert system for short-term electrical charge forecast with parallel control of the demand and are based on historical data of the last 5–10 years. The system of David and Zhao [22] simulates the extension of electrical installations via a completed expert system that makes use of dynamic planning. Another similar expert system is the NETMAT that was developed by Zitouni and Irving [23], while COLOMBO [24] is

a system that proposes the planning of electrical generation, as well as the planning of cogeneration plants. Additionally, expert systems exist for the short-term engagement of units [25,26], as well as for various other applications of energy and climate policy [27–29].

Furthermore, expert systems are used mainly for the registration and analysis of errors in stations or substations [30–33], in situations of network overload, in the regulation of relays so that they function more precisely and efficiently [34], as well as in an alarm process [35,36] for the protection of the energy system. Another expert system is SOCRATES [37], which is used for the confrontation of extraordinary incidents in the networks transmission and the distribution of electricity, while a study by Khosla and Dillon [38] constitutes an approach with a combination of an expert system and some networks.

Moreover, the expert systems have penetrated in the restoration of the network after power-offs [39]. The expert systems are mainly used for data collection and decision making after the collapse of the network, and also for the simulation, in computer, of the situation at which the system collapses [40]. Most of them are connected "on-line", for example the system proposed by Brunner et al. [41], in order to provide help in the operators. Also, the proposal of Nagata et al. [42] is very interesting, because it examines a model, which, combining expert systems with mathematic planning, analyzes the cost involved in the restoration of the operation network. Another expert system in the energy sector is SPARSE [43], which is used in the Portuguese distribution network. The application of expert systems in the restoration of networks occupied also Park and Lee [44] who tested their system in a local network. In addition, the desirable regulations of voltage are achieved automatically via expert systems [45–49]. Lastly, important applications of expert systems dealt with the safety of RES production units [50–52], while various applications involve the energy efficiency [53–56].

Based on the above, the expert systems have many important applications in various issues regarding the operation of the energy companies and as a result they are intensely used in specialized technically energy problems. However, their use in problems of knowledge representation for the support of decision making for the formulation of a modern energy companies' environment is inexistent.

2.3. MCDM systems

The most important research MCDM methodologies and systems that are related to the parts of the current problem are presented as follows.

Siskos–Hubert [57], presented an evaluation of RES, while Mirasgedis–Diakoulaki [58] evaluated the environmental and social consequences, as well as the consequences on the human health, which are calculated for a number of energy production units when alternative fuels are used. Marks [59] dealt with the energy conservation and in particular with the minimization of the annual expenditures for heat by using the CAMOS program.

Pokharel–Chandrashekar [60] proposed a new way of approaching the analysis of different energy alternatives in isolated regions, as far as it concerns the coverage of energy demand, with the use of multi-criteria systems. Gandibleux [61] presented an interactive multi-criteria procedure (CASTART) for the selection of alternative ways of energy production.

Goumas et al. [62], presented an application of some decision making systems that was developed in operational research for the best utilization of geothermal sources. Gupta et al. [63]

searched the risk evaluation procedure for companies that apply the venture capital mechanisms. Beccali et al. [64] presented an application for the promotion of RES technologies in local level. Nigim et al. [65] presented a classification tool, as well as an interactive tool for the rural retention (SIMUS). Koroneos et al. [66] applied a PYA methology in the island of Lesvos, in Greece, where there is an adequate amount of RES in order to cover part of the island's energy needs. Giannantoni et al. [67] proposed a repeatable system for the evaluation and improvement of the energy systems' design; this work deals with the advantages and disadvantages of the suggested solutions. Diakoulaki et al. [68] examined four independent scenarios for the expansion of three Greek energy systems.

Cavallaro et al. [69] presented a preliminary evaluation regarding the possibility of setting some wind generators in the island of Salina (part of the Aeolian islands in Italy). Madlener et al. [70] proposed a system for the design of tools for RES policy, taking into consideration the new parameters of energy market. Kaklauskas et al. [71] presented a system of complex multi-criteria evaluation (COPRAS) for the energy conservation in buildings. Stagl [72] presented a work that examines a case of decision making regarding some choices of energy offer in the means of rapid development where environmental, social and financial goals are taken into consideration.

3. The methodology

The methodology incorporates the following five components:

Component 1—identification: This component concerns the identification, based on the experience (mainly in the EU), of 16 actions. Firstly, the dimensions (D_i) of the environment can be categorized in four dimensions—the political, financial and social dimension, as well as the dimension of research—technology ($i = 1, 2, 3, 4$)—taking into consideration the literature that is related to the companies' operational environment and its strategy [73]. Based on the literature review, the necessary actions toward the formulation of a modern energy companies' operational environment (A_{ij}) are categorized as they have been recently presented by Patlitziana [74] in the following Table 1.

Component 2—modeling: The second component concerns the modeling of the energy companies' operational environment, via the development of a group of appropriate indicators. In particular

- Sixteen basic indicators (B_{ij}, $i = 1, 2, 3, 4$, $j = 1, 2, \ldots, a$) present the most essential information regarding the diagnosis of the country's performance, in terms of its energy companies' operational environment. The basic indicator is the key means of decision making for the necessity of taking intervention measures or not.
- Some other indicators create a new group that includes the secondary indicators S_k, ($k = 1, 2, \ldots, m$). The secondary indicators act as accessory to the estimation of the weaknesses of the energy companies' operational environment. These indicators are focused on specified issues of the weaknesses of the energy companies' operational environment and describe specific activities for selected aspects of the sectors they examine. The selected secondary indicators are 40.
- A third group of indicators is created, representing the effects that the "new parameters" of the companies' market involve in the decision making regarding the formulation of their operational environment N_l, ($l = 1, 2 \ldots, n$). The new parameters' selected indicators are 21.

Table 1
The action

D_1—Political dimension	D_2—Financial dimension	D_3—Social dimension	D_4—Research and technology dimension
$A_{1.1}$—Supporting policy programmes of energy production from RES	$A_{2.1}$—Investment support of RES	$A_{3.1}$—Supporting employment for RES-EE	$A_{4.1}$—Supporting R&D on technologies of energy production by RES
$A_{1.2}$—Verification system for ESCOs	$A_{2.2}$—Investment support of energy management	$A_{3.2}$—Supporting social acceptance for the RES projects	$A_{4.2}$—Supporting R&D on EE's technologies
$A_{1.3}$—Standardization of energy services contracts	$A_{2.3}$—Investment support of EE	$A_{3.3}$—Supporting education for RES–EE	$A_{4.3}$—Supporting best practices and technology
$A_{1.4}$—Supporting policy programmes of EE promotion	$A_{2.4}$—Promotion of new financing sources for RES–EE projects	$A_{3.4}$—Developing energy companies in the region	
$A_{1.5}$—Enhancement of energy cooperation			

The selected indicators are based on the literature survey and they consist apart from the technology and techno-physical indicators, of indicators, such as research & development (R&D) expenditures and some socioeconomical indicators (e.g. employment, turnover).

Component 3—estimation: The third component concerns the estimation of the necessity for each action (A_{ij}) of the energy companies' operational environment. Concretely, the basic indicator is related to a group of secondary indicators. Moreover, a second group of indicators, reflecting the impact of "new parameters", is related to every basic indicator. As a result, there are selected:

- The group of the correlated indicators of "new parameters" (N_{ilx}, $x = 1, 2, 3, \ldots, b$).
- The group of the correlated secondary indicators (S_{ijy}, $y = 1, 2, 3, \ldots, c$).

In this way, a "group of decision indicators" is created, the price control of which portrays the estimation of the "existence of the necessity or not" for improving the companies' operational environment.

Component 4—choice: After the estimation of the action's necessity, the model investigates the intervention choices, based on the evolution indicator's DB_{ij} values. This indicator illustrates the evolution of the Basic Indicator's performance during the past year.

The value of the above-mentioned indicator is estimated according to appropriate thresholds and the existence/non-existence of appropriate measures in the past year is examined. In this context, the continuation of the existing measures (I), their modification (II) or the formulation of new measures (III) is proposed.

Component 5—order: The last component receives as input the results of the previous components, in order to evaluate the direct actions that have to be implemented for the development of the energy companies' operational environment in each country, and involves a methodology of quantifying multiple qualitative judgments based on the ELECTRE III method [75]. The six criteria are selected so as to incorporate all the needs of the companies' operational environment, as well as the emerging needs and opportunities of the "new parameters" that determine the final decision.

Table 2
The criteria

Category	Priority criteria
Basic needs	C1: Contribution to the increase of the RES proportion C2: Contribution to the increase of the EE C3: Contribution to the security of supply C4: Contribution to the sustainable development
New parameters	C5: Progress regarding the liberalization of the energy market C6: Contribution to the reduction of the greenhouse gases

In addition to this, the member-states' performance to each one of the criteria is based on a 1–5 order qualitative scale, with "1" illustrating an insignificant progress of the country regarding the particular criterion, "2" a low, "3" a moderate, "4" a high and "5" a very high progress of the member-state regarding the particular criterion. The criteria are presented in Table 2.

The weights of the first four criteria of each dimension were defined to be "0.200", while the last two criteria of each dimension, which express the impact of the "new parameters" (liberalization of energy market and climate change) in the final result, were defined to be "0.100". The weights express the view of the "decision maker", and, as a consequence, the results range between subjectivity and objectivity.

The methodology procedure is described in the following Fig. 1.

4. The information decision support system

The methodology has been incorporated in the information system by the name of decision information system for formulation of energy companies operational environment (DISFECOE). The following Fig. 2 plots the architecture of the system that has been created.

As shown in the above figure, the system consists of two subsystems as follows.

4.1. First subsystem: expert system for formulation of energy companies operational environment (ESFECOE)

The subsystem that is responsible for the estimation of the necessity for action and the choice of the way that an action should be made is named ESFECOE.

This subsystem was developed with XpertRule Knowledge Builder, a product of Attar Software Limited, and incorporates the expert system for the evaluation of the situation and the selection of the way that an action should be made in the energy companies' operational environment. The subsystem uses the values of certain indicators and consists of the typical and essential parts of every expert system. In particular:

- *Database:* The database consists of objects, attributes and strings. The larger amount of data consists of (a) the gathered information about the actions that should be made in order to formulate a modern operational environment for the energy companies, (b) some extra information that is necessary for the calculation of the indicators that is

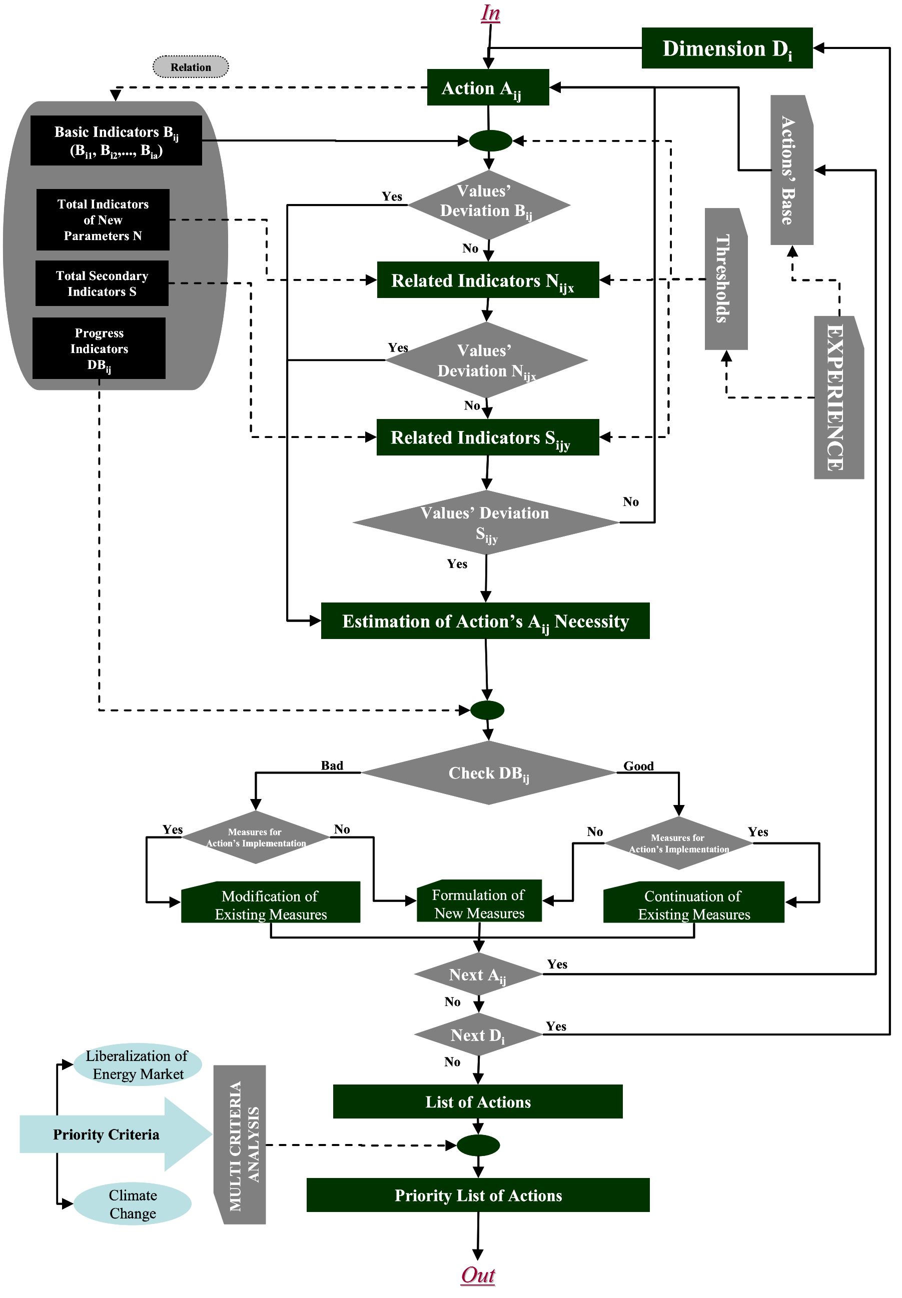

Fig. 1. The methodology procedure.

based on annual energy data and the "library" of the estimation conclusions. The database also stores the list of rules that are examined and applied, and therefore the program can provide the user anytime with the proper justification.

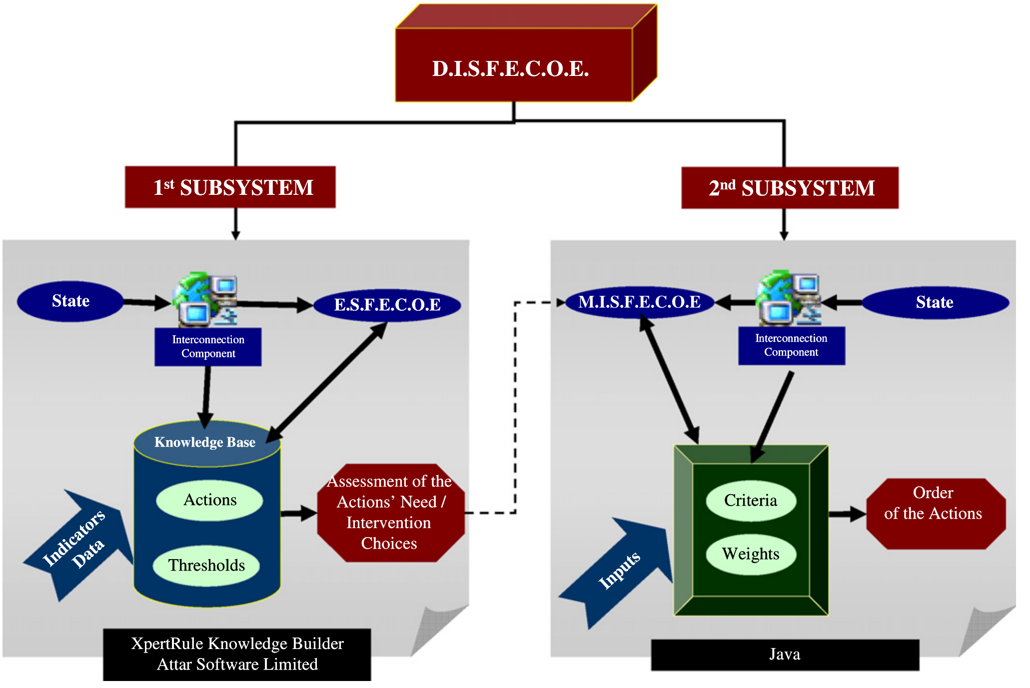

Fig. 2. The architecture of the information decision support system.

- *Knowledge base:* It consists of all the rules that present the knowledge that was modelled. Those rules evade the analysis of the procedures of the third and fourth component of the suggested methodology. Totally, the knowledge base consists of approximately 350 rules, which were developed using rule sets ("if … then …").
- *Interconnection component:* Between the program and the user, it consists of a number of dialogs, which are categorized in (a) forms of data input and (b) forms of results presentation. The operation of the subsystem has the following stages:
  - *Introduction:* The user is welcomed and introduced to the library of actions.
  - Data input: The program presents the forms that concern the selection of the operational environment for a certain country and for a certain year. Appropriate forms ask the user to insert the values of certain energy indicators in each one of the four dimensions of the energy companies' operational environment. In particular, the program introduces the user to the examination of the political dimension. Next, the user is introduced to the examination of the first action of the political dimension through the incorporation of the values of the indicators that the program asks (Fig. 3) until the evaluation of the necessity for intervention "ACTION1.1" is made.
  - *Output:* The main results of the subsystem are shown on the final form for the evaluation of the necessity in each dimension of the energy companies' operational environment, as well as the way that each action should be made (I, II and III), as shown in Fig. 4.

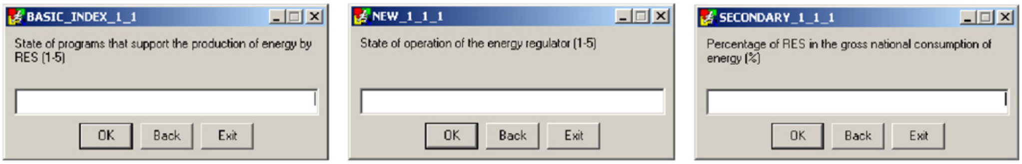

Fig. 3. The forms of ESFECOE' inputs.

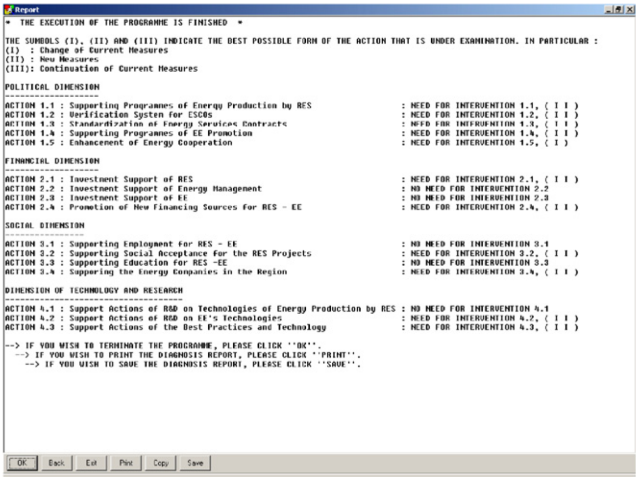

Fig. 4. The form of ESFECOE' outputs.

4.2. Second subsystem: multicriteria information system for formulation of energy companies operational environment (MISFECOE)

The subsystem that is responsible for the evaluation and the order of the proposed actions is named "MISFECOE". This subsystem was developed with Java and incorporates the methods of ELECTRE III customized according to the specific problem for ranking the actions in energy companies' operational environment.

Due to the large amount of calculations and in particular due to the large amount of the records' production that evade the binary comparisons in ELECTRE III, it is obvious that those calculations cannot be made in a short period of time and without mistakes without the use of a proper software. The binary comparisons that demand data input by hand, as well as control in intermediate stages, deterred the use of Excel (Microsoft Office). For the above reason, the subsystem MISFECOE was created and incorporates the fifth component of the methodology as well.

This subsystem was developed with Java, so that it can give the user the opportunity of dynamic variation of certain amounts, such as the number of actions or criteria, which is very essential in case of equality in marks of some alternatives as presented in the Fig. 5. In case some alternatives get the same marks the system must be applied again.

In particular, the subsystem starts and has as defaults elements the criteria and the actions for the formulation of a modern operational environment for the energy companies. A very important advantage of the subsystem is the functionality and the

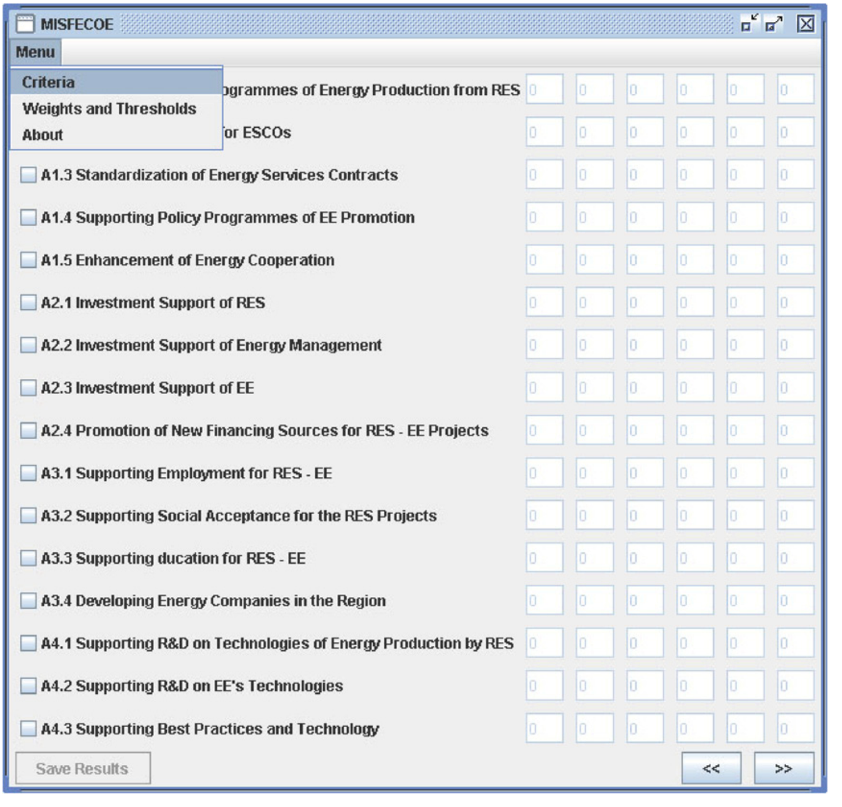

Fig. 5. The form of MISFECOE' inputs.

ease of change of all the parameters. Through ".txt"—type files the user has the chance to save (or even to insert) the actions, the criteria, the assignment of performances, as well as the weights and thresholds. The dynamic form of the subsystem makes possible its interconnection with the first subsystem.

The subsystem is also user-friendly since it provides the user the opportunity to change all the related parameters. In particular, the subsystem gives the user the opportunity to examine two additional cases that will represent the effect of the "new parameters" of the energy market in the final decision.

In particular, initially the case of increased activation for the energy liberalization and the climate change is chosen, and then the reverse case. The results of the subsystem are stored in a proper file and are presented in descending order. In another «txt» file, the relevant assignment of performances is stored. In case of equality in marks, the user is asked to run the program again only with the alternatives that get the same marks.

In addition, for accuracy control reasons of the application, the program creates a number of files that include the agreement, disagreement and reliability matrices, as well as the graduation of the alternatives in order of their input in the program and the matrix that leads in the classification of the alternatives.

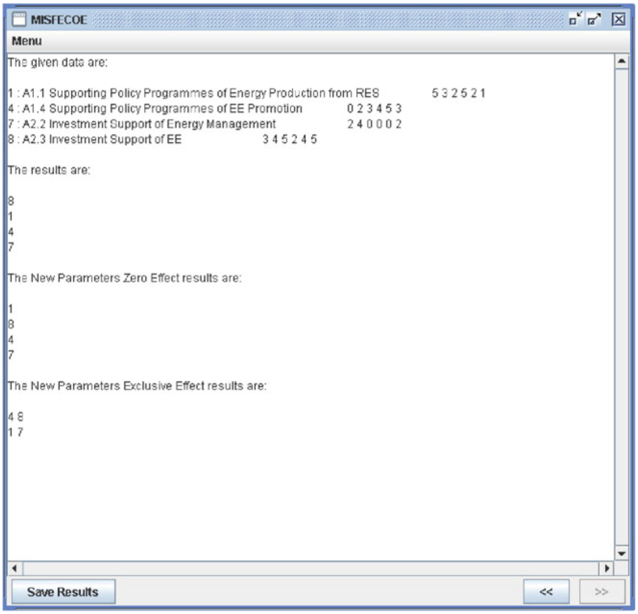

Fig. 6. The form of MISFECOE' outputs.

Therefore, the subsystem presents in the final form (Fig. 6) the classification for the cases (all criteria, only basic criteria, only criteria of new parameters).

Through the settings menu, the user can see at anytime the definitions of the actions' classification criteria through the choice "criteria legend" as it has been described above. In addition, the user can change the weights and thresholds that formulate the initial stage of the criteria. By choosing "change of thresholds and weights" the user is introduced to a form for changing them.

4.3. Application

The information system was successfully applied in the 10 new member states (Cyprus-CY, Czech Republic-CZ, Estonia-EE, Hungary-HU, Lithuania-LT, Latvia-LV, Malta-MT, Poland-PL, Slovenia-SL, Slovakia-SK), which joined the EU in 2004, in Bulgaria-BG and Romania-RO that are going to join the European Union in 2007, as well as in Croatia-HR that has started negotiations with EC. The inputs are based to a large extent on the context of the FP6 project: "Scientific Reference System on New Energy Technologies, Energy End-use Efficiency and Energy RTD" [76].

In particular, the outputs of qualitative indicators as well as the performance of criteria are based on the conclusions derived from the resultful core-group meetings of the "Scientific Technical Reference System on Renewable Energy and Energy End-Use Efficiency" [77].

The results of the proposed model's application in the above states are presented in the following Table 3. In particular, the actions examined are ranked, from the most necessary ones to those of lowest priority for two cases (all criteria, only basic criteria).

Table 3
The application results

State	Case A—All the criteria	Case B—Only the basic criteria
EE	$A_{2.1}(II) > A_{1.1}(III) > A_{2.3}(II) > A_{3.4}(II) > 2.4(II) > A_{2.2}(II) > A_{4.2}(II)$	$A_{1.1}(III) > A_{2.3}(II) > A_{2.1}(II) > A_{3.4}(II) > A_{2.2}(II) > 2.4(II) > A_{4.3}(II) > A_{4.2}(II)$
CY	$A_{1.1}(III) > A_{2.1}(II) > A_{2.3}(II) > A_{2.4}(II) > A_{1.3}(II) > A_{3.4}(II) > A_{1.5}(II) > A_{1.2}(II) > A_{4.2}(II) > A_{4.1}(II)$	$A_{1.1}(III) > A_{2.1}(II) > A_{1.2}(II) > A_{1.3}(II) > A_{3.4}(II) > A_{2.3}(II) > A_{2.4}(II) > A_{1.5}(II) > A_{4.2}(II) > A_{4.1}(II)$
LT	$A_{1.5}(II) > A_{1.2}(II) > A_{2.3}(II) > A_{2.2}(II) > A_{2.4}(II) > A_{3.4}(II) > A_{3.3}(I) > A_{3.2}(II) > A_{4.2}(I) > A_{3.1}(II) > A_{4.1}(I)$	$A_{1.2}(II) > A_{2.3}(II) > A_{3.4}(II) > A_{1.5}(II) > A_{2.2}(II) > A_{3.3}(I) > A_{2.4}(II) > A_{3.1}(II) > A_{3.2}(II) > A_{4.1}(I) > A_{4.2}(I)$
LV	$A_{2.1}(II) > A_{1.5}(II) > A_{2.3}(II) > A_{3.4}(II) > A_{2.4}(II) > A_{3.3}(II) > A_{3.1}(II) > A_{4.1}(II) > A_{4.2}(II)$	$A_{2.1}(II) > A_{2.3}(II) > A_{3.4}(II) > A_{1.5}(II) > A_{2.4}(II) > A_{3.3}(II) > A_{3.1}(II) > A_{4.1}(II) > A_{4.2}(II)$
MT	$A_{1.1}(II) > A_{2.1}(II) > A_{1.4}(II) > A_{2.4}(II) > A_{1.2}(II) > A_{1.3}(II) > A_{3.4}(II) > A_{1.5}(I) > A_{4.3}(II) > A_{4.2}(II) > A_{3.2}(II)$	$A_{1.1}(II) > A_{2.1}(II) > A_{1.4}(II) > A_{1.2}(II) > A_{1.3}(II) > A_{3.4}(II) > A_{1.5}(I) > A_{2.4}(II) > A_{3.2}(II) > A_{4.3}(II) > A_{4.2}(II)$
HU	$A_{2.1}(II) > A_{2.3}(II) > A_{3.4}(II) > A_{2.4}(II) > A_{3.3}(II) > A_{3.1}(II) > A_{4.1}(II)$	$A_{2.1}(II) > A_{2.3}(II) > A_{3.4}(II) > A_{2.4}(II) > A_{3.3}(II) > A_{3.1}(II) > A_{4.1}(II)$
PL	$A_{2.1}(II) > A_{1.1}(III) > A_{1.4}(II) > A_{3.4}(II) > A_{4.3}(II) > A_{4.2}(II) > A_{4.1}(II)$	$A_{1.1}(III) > A_{2.1}(II) > A_{1.4}(II) > A_{3.4}(II) > A_{4.3}(II) > A_{4.2}(II) > A_{4.1}(II)$
SK	$A_{1.1}(I) > A_{2.1}(II) > A_{1.4}(II) > A_{2.4}(II) > A_{1.2}(II) > A_{1.5}(II) > A_{1.3}(II) > A_{3.4}(II) > A_{3.3}(I) > A_{4.2}(II) > A_{3.1}(II) > A_{3.2}(II)$	$A_{1.1}(I) > A_{1.4}(II) > A_{2.1}(II) > A_{1.2}(II) > A_{1.3}(II) > A_{1.5}(II) > A_{2.4}(II) > A_{3.4}(II) > A_{3.3}(I) > A_{3.1}(II) > A_{3.2}(II) > A_{4.2}(II)$
SL	$A_{2.1}(II) > A_{1.4}(II) > A_{2.3}(I) > A_{1.3}(II) > A_{2.2}(II) > A_{2.4}(II) > A_{3.3}(II) > A_{3.4}(II) > A_{4.2}(II) > A_{3.2}(II) > A_{3.1}(II) > A_{4.1}(II)$	$A_{2.1}(II) > A_{1.4}(II) > A_{1.3}(II) > A_{2.3}(I) > A_{3.4}(II) > A_{3.3}(II) > A_{2.2}(II) > A_{2.4}(II) > A_{3.1}(II) > A_{3.2}(II) > A_{4.1}(II) > A_{4.2}(II)$
CZ	$A_{1.1}(III) > A_{1.4}(II) > A_{2.1}(II) > A_{2.2}(II) > A_{2.3}(II) > A_{1.2}(II) > A_{1.3}(II) > A_{3.4}(II) > A_{1.5}(II)$	$A_{1.4}(II) > A_{1.2}(II) > A_{1.3}(II) > A_{1.1}(III) > A_{2.1}(II) > A_{2.2}(II) > A_{2.3}(II) > A_{3.4}(II) > A_{1.5}(II)$
BG	$A_{1.1}(II) > A_{2.1}(II) > A_{2.3}(II) > A_{2.2}(II) > A_{2.4}(II) > A_{3.4}(II) > A_{1.2}(II) > A_{1.3}(II) > A_{4.1}(II)$	$A_{1.1}(II) > A_{1.2}(II) > A_{1.3}(II) > A_{2.1}(II) > A_{2.3}(II)\ A_{3.4}(II) > A_{2.2}(II) > > A_{2.4}(II) > A_{4.1}(II)$
RO	$A_{1.4}(I) > A_{1.2}(II) > A_{1.5}(II) > A_{1.3}(II) > A_{2.3}(II) > A_{2.2}(II) > A_{2.4}(II) > A_{3.4}(II) > A_{3.3}(I) > A_{3.2}(II) > A_{3.1}(II) > A_{4.1}(II)$	$A_{1.4}(I) > A_{1.2}(II) > A_{1.3}(II) > A_{1.5}(II) > A_{2.3}(II) > A_{3.4}(II) > A_{3.3}(I) > A_{2.2}(II) > A_{2.4}(II) > A_{3.1}(II) > A_{3.2}(II) > A_{4.1}(II)$
HR	$A_{1.1}(II) > A_{2.1}(II) > A_{1.4}(II) > A_{2.3}(II) > A_{2.2}(II) > A_{1.5}(II) > A_{1.2}(II) > A_{1.3}(II) > A_{2.4}(II) > A_{3.4}(II) > A_{3.3}(II) > A_{4.3}(II) > A_{4.2}(II) > A_{3.2}(II) > A_{3.1}(II) > A_{4.1}(II)$	$A_{1.1}(II) > A_{1.4}(II) > A_{2.1}(II) > A_{1.2}(II) > A_{1.3}(II) > A_{1.5}(II) > A_{2.3}(II) > A_{3.4}(II) > A_{2.2}(II) > A_{2.4}(II) > A_{3.3}(II) > A_{4.3}(II) > A_{3.2}(II) > A_{3.1}(II) > A_{4.2}(II) > A_{4.1}(II)$

5. Conclusions

Summarizing the above, the information decision making system has the following advantages:

- Possibility of exporting a suitable actions list that contains and classifies all necessary actions,in exceptionally less time than the time needed without the use of an information system that incorporates the methodology.
- Possibility of controlling the flexibility of results, thus offering an additional list of actions by the information system without taking into consideration the new parameters (null effect of criteria of new parameters). Based on the analysis of the results' flexibility, the variations of the places of each action are rather small and insignificant in Case A. This is an expected result because this particular study is focused on countries that have not yet incorporated totally the "new parameters" in their internal energy market.
- Possibility of controlling the thresholds that were used (in quantitative/qualitative indicators and in criteria) for exporting the results, a fact that can essentially contribute to the control and correction of errors and false choices.

Therefore, the information decision support systems, such as the one presented in this paper, are necessary in order to identify, diagnose and classify the appropriate actions in a consistent way, to assist policy making and to formulate a modern energy companies' operational environment. In addition, the model's procedure assisted the specific decision-making problem and the outcome might have been quite different if different indicators and criteria had been chosen. However, the information system concept can provide a sufficient framework for supporting decisions for other problems.

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